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FORUM

The Computer Industry in Belgium†

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I. INTRODUCTION

Information is a strategic resource for the competitive performance of advanced economies. There are two main reasons for this strategic importance. First, economic activities have become increasingly interdependent and complex. Second, the knowledge intensity of economic activities has increased considerably. Competitive performance of an economy in the future will depend more and more on its ability to coordinate complex and interdependent activities and to acquire and dessiminate knowledge. It is consequently not surprising to find that in all advanced economies the information sector holds an inportant and a growing position.

Recently economists such as Porat (1976) and Jonscher (1983) have begun to define the information sector and to estimate its importance. In defining the information sector it has proven useful to distinguish between products and activities. All goods and services that collect, store, process and communicate information are considered to belong to the information sector. The sector can be split in two parts. The first part is the primary information sector. It includes all products sold on establishment markets. The second part is the secondary information sector and it consists of these information products and activities that are not subject to transactions across markets because the products and activities are for internal use in the firm or organisation.

The importance of the primary and secondary information sectors

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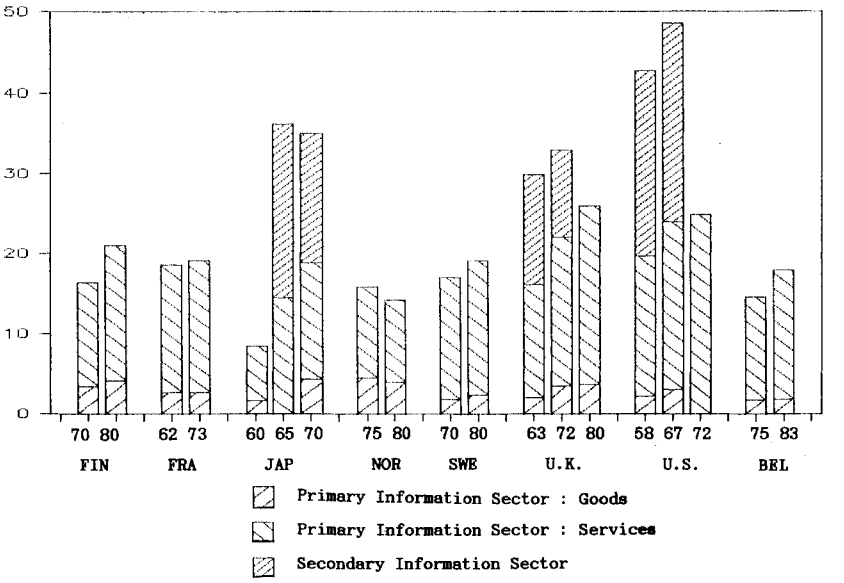
in the national economy is given for various countries in Figure 1. Data for the secondary sector were only available for the U.S. and Japan. More details on the composition of the Belgian primary sector are presented in Appendix 1.

FIGURE 1

Primary and Secondary Information Sector as a percentage of GDP at factor cost



Source: OECD (1981) and INCAP.

The data show that the information sector accounted for about half of GDP in the U.S. around 1970. Developed economies can be characterized as information economies. In 1983 the Belgian primary information sector constituted about 18% of GDP. In 1975 this was only 14.3% which implies a rapid growth. The Belgian primary information sector mainly consists of information handling services. Close to 90% of GDP created in the primary information sector is estimated to be the result of service activities. But even this high estimate might be too low because the value added created by activities in trade are not included. Belgium, however, is not unique because the composition of the primary information sector is very similar in other contries.

The rapid growth of the information sector is influenced by the demand and the supply for information. Detailed information on the demand side is hard to come by in Belgium. But the experience of the United States suggests that the business sector is by far the largest

user of information. Data collected by Jonscher suggest that for every dollar spent by the final consumer the business sector spent 7 dollars. Within the business sector the needs for information differ. Larger firms use information products more than smaller firms. The need for information also depends on the industry in which the firm is operating. Knowledge intensive industries and industries confronted with complex interdependencies appear to use information most intensively. Even within the firm information needs vary. Information needs are greatest in accounting, market research, personnel management and customer account management.

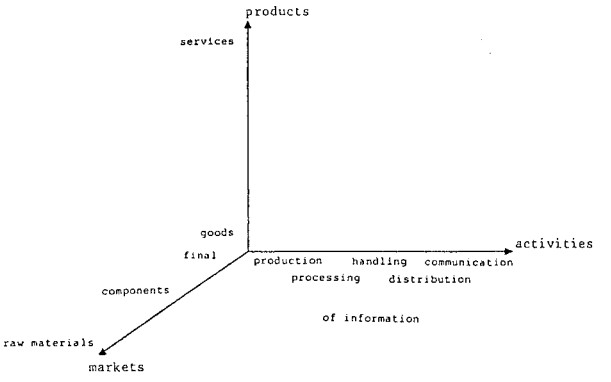
More than demand factors supply factors seem to have shaped the evolution of the information sector. Scientific and technological developments have led to new information technologies which have revolutionized information products and activities. In this way information technologies have greatly contributed to the rapid development of the information sector.

II. INFORMATION TECHNOLOGIES

A rich variety of information technologies exists today. Some information technologies are very old like books, others are brandnew like videotex. Some classification is necessary to make a meaningful analysis possible. It has proven useful to look at three characteristics: products, activities and type of market. In Figure 2 some examples are given to illustrate the usefulness of this three-dimensional classification.

FIGURE 2

Information technology products dimensions



Source: INCAP

Information technologies not only differ in the products they supply, the activities they perform and the type of markets they serve. Most importantly they differ in the technology they use. The electronic revolution has made a wide ranging set of new information technologies possible such as: radio and TV; sound, video and data recording and reproduction equipment; telecommunication; computers and robots; numerically controlled machine tools.

The evolution of the information sector and of the information technologies is intimately connected with the evolution of the computer and robot industry. Computers and robots, together with telecommunication equipment, are at the edges of the technological revolution in information technologies. All of this strongly suggests to adopt a sufficiently broad view of the information technology (IT) industry, see Appendix 2. The computer industry is but one of the important parts of the IT industry. In terms of the NACE industrial classification the computer industry includes the manufacturing of office machines and data processing equipment (NACE-code 330), the wholesale trade in such machines and equipment (NACE-code 614.4) and the electronic data processing services (NACE-code 839.2).

Typical for the computer and robot industries is that they consist of hardware and software. The importance of software has grown dramatically. According to estimates made by the OECD, software will account for 80% of total costs in 1985. Thirty years ago software accounted for less than 20%.

Computers and robots are used in the private and the public sector. Table 1 shows that banks and insurance companies spent nearly 23 billion BF on computers in 1983. This made them by far the largest spenders on computers in Belgium. They even outspent the government which in 1981 spent 10 billion BF on computers (see Table 2). In the national government the Ministry of Economic Affairs was the largest computer user followed at some distance by the Ministries of Defence and Finance. Table 3 shows that in 1984 robots were used most in the car manufacturing industry and in education. International comparisons suggest that Belgium does not lag behind other countries in the use of computers and robots (Table 4). All this raises questions about the position of Belgium in the supply of information technologies in general and the computer and robot technologies in specific. These questions are taken up in the next section.

TABLE 1

Degree of Computerization: Computer Expenditures by Industry (1983)

Industry	Number of comp.	Avg. budget (.000 BF)	Ind. budget (.000 BF)	Percent of total
Wholesale trade	2,981	4,765	14,204,465	14.0
Business services	2,034	5,837	11.872,458	11.7
Public services	1,345	4,816	6,477,520	6.4
Retail trade	889	1,826	1,623,314	1.6
Other services	854	5,814	4,965,156	4.9
Metal articles and machinery	803	3,216	2,582,448	2.6
Other manufacturing industries	779	4,101	3,194,679	3.2
Building and civil engineering	682	3,234	2,205,588	2.2
Minerals, chemicals, etc.	656	13,026	8,545,056	8.4
Finance and insurance	612	37,354	22,860,648	22.6
Transport and communication	594	6,258	3,717,252	3.7
Food and beverages	543	7,362	3,997,566	4.0
Paper and publishing	479	5,748	2,753,292	2.7
Textiles	455	3,609	1,642,095	1.6
Office and DP mach.; electr. end	306	8,457	2,587,842	2.6
Transportation equipment	234	5,583	1,306,422	1.3
Mining; iron and steel	200	20,971	4,194,200	4.1
Leather and clothing	155	2,826	438,030	0.4
Precision instruments	144	4,089	588,816	0.6
Repair shops	108	1,441	155,628	0.2
Energy and water	108	10,638	1,148,904	1.1
Agriculture	72	942	67,824	0.1
Hotels, restaurants and cafes	18	1,535	27,630	0.0
Total	15,051	6,721	101,156,833	100.0

Source: Eurodatum – ASAB/VEBI (1984)

TABLE 2

Government Computer Expenditures (Million BF and Percent)

	1978	1979	1980	1981
Total public sector	7471	8083	8962	9906
Growth rate		8.2	10.9	10.5
% of budget	0.78	0.79	0.84	0.82
Central Administration			3182	3567
Growth rate				12.1
% of budget			0.30	0.30

Source: Bodart (1984, p.9).

TABLE 3

Utilization of robots in Belgium

	Units	% 83	% 82
Car manufacturing	298	58	62.6
Mechanical engineering	64	12.5	15.5
Plastics	16	3	3.9
Electronics	10	2	2.9
Transformation of metals	14	3	3.3
Education	79	15.5	
Other	33	3	

Source: BIRA (1984)

TABLE 4

Intensity of Robot Use in Various Countries

	Units of robots	Industrial population × 1000	Intensity %
1. Sweden	1.900	1.352	0,141
2. Japan	16.500	19.556	0,084
3. Germany	4.880	11.334	0,043
4. Belgium	514	1.332	0,039
5. United Kingdom	1.753	5.272	0,033
6. United States	8.000	29.774	0,027
7. Italy	1.800	7.787	0,023
8. France	1.500	7.574	0,020

Source: BIRA (1984)

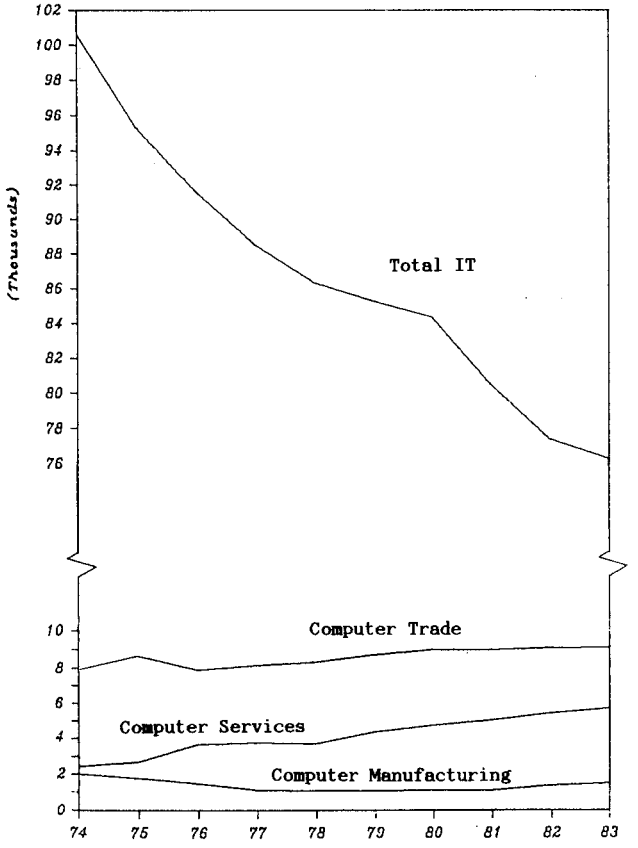
III. WEAK IN HARDWARE, STRONG IN SOFTWARE?

How well does the Belgian economy perform in the information technology industries? A variety of measures can be used to describe performance. Employment, value added and trade are some of the more important descriptive indicators and they are also most easily available. In addition it is important to describe the dynamic evolution of the industries involved. This can be done by analysing the expansion and contraction of existing firms and the entry of new firms.

Figure 3 shows the evolution of employment in the information technology (IT) industries, in the computer manufacturing industry, in computer services and in computer trade. The data show that

FIGURE 3

Employment trends for information technology industries in Belgium



Source: R.S.Z. / O.N.S.S.

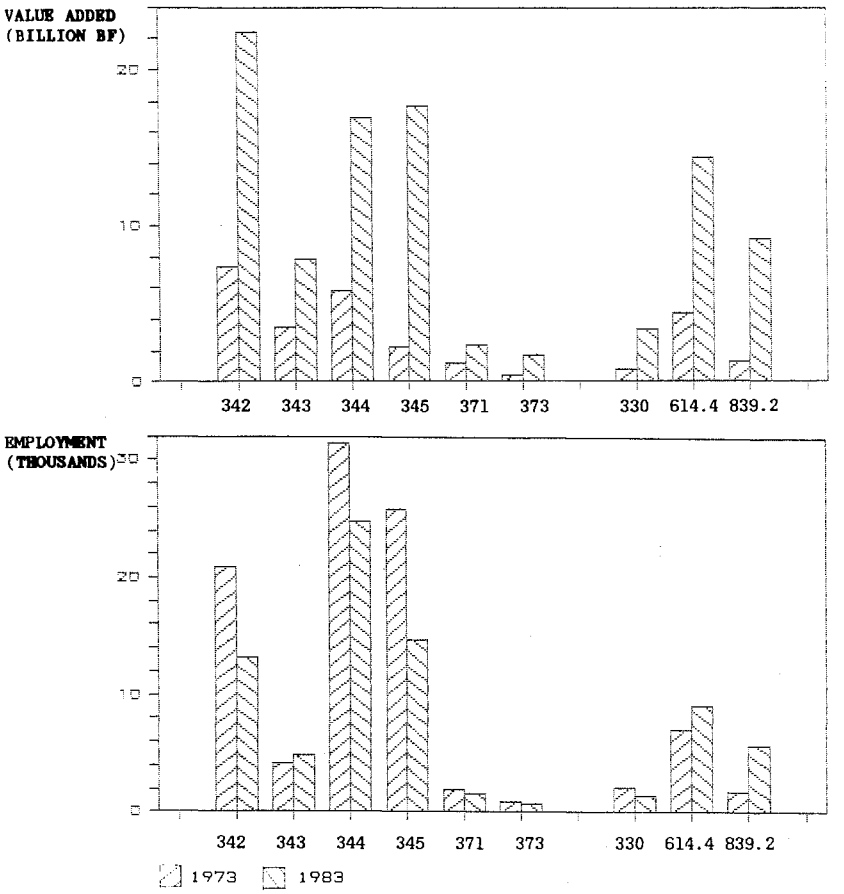
employment in information technology industries has declined without interruption over the course of the last decade. With the exception of 1982 and 1983 employment in computer manufacturing has declined also in contrast with this overall decline of jobs in the production of hardware, employment in computer trade and services has increased.

Figure 4A and 4B give a detailed comparison of employment data and value added data. Again it is clear that income created in the production of hardware has grown slower than income created in computer trade and services.

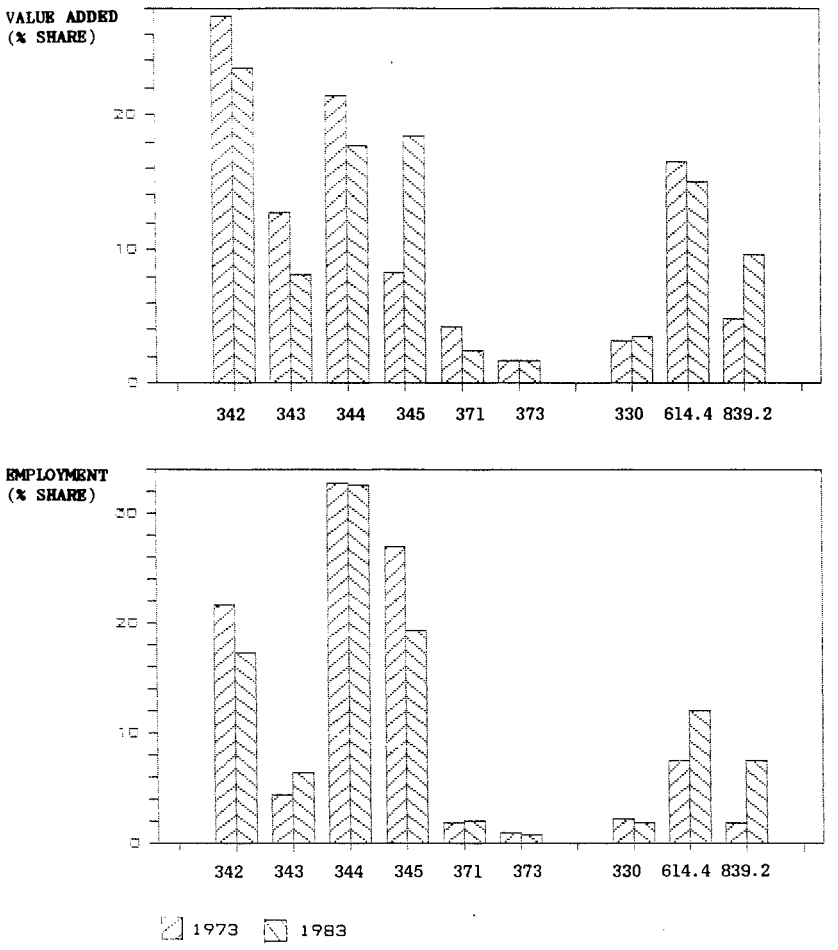
FIGURE 4

Positioning the computer industry in the information technology industries Belgium 1973 and 1983

4A. *Absolute*



4B. *Relative*



Legend*:

342 Basic electrical equipment
343 Electrical apparatus
344 Telecommunications equipment
345 Radio/TV receivers
371 Instruments
373 Optical instruments
330 Computer manufacturing
614.4 Computer trade
839.2 Computer services

* See Appendix 2 for exact descriptions.

A dynamic picture of the evolution of an industry can be obtained by studying changes in the number and the sizes of firms operating in the industry. Fig 5A and 5B map the dynamics of industry evolution in four quadrants. Expanding industries are located in the upper right quadrant. Both the number of firms and employment are increasing. The upper left quadrant shows industries with expanding employment but a declining number of firms. In the lower left quadrant contracting industries are found. In these industries both employment and the number of firms are declining. Finally in the lower right quadrant employment is declining but the number of firms is increasing. Fig 5A shows the absolute changes. This permits an assessment of the importance of the industries in the economy. Fig. 5B gives the relative changes, which describe the dynamics of each industry irrespective of size.

The data reveal an important contraction in the audio and video industry as well as important employment losses in the basic electrical equipment and the telecommunications and measuring and recording equipment. On the other hand, the computer trade and especially the computer services show an important expansion, both in absolute and relative terms. Computer manufacturing is going through a process of fragmentation with an increasing number of firms but fewer jobs. Software industries, therefore, appear to fit the comparative advantages of the Belgian economy better than hardware industries. This important conclusion deserves some further attention.

Figure 6 reveals that the Belgian economy relies more on imports than on domestic production to satisfy its computer needs. The majority of domestic production of computers is destinated for export markets.

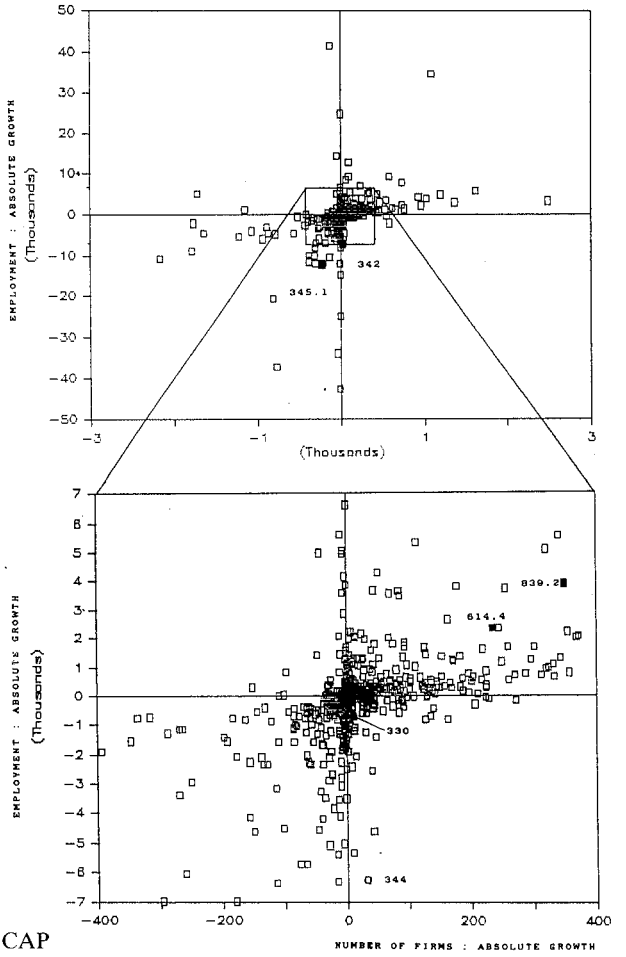
A similar conclusion holds for the manufacturing of robots. Only 1% of the robots installed in Belgium in 1983 were manufactured in Belgium. Other European countries were the largest suppliers of robots used in Belgium.

The ability of the computer manufacturing industry to create income is rather small and is rapidly deteriorating. This can be seen best in Figure 7 which shows the value added to sales rates ratio for the computer manufacturing industry. The ratio illustrates that vertical integration in computer manufacturing is declining. From a more detailed analysis of this phenomenon it was learned that the decline may well be due to a rather dramatic decrease in the value added to sales ratio of the largest companies in the industry.

FIGURE 5

Mapping industry dynamics (1973-1983): Belgian economy (NACE 4 Digit) and information technology industries (1)

5A. *Absolute changes*



Source: INCAP

(1) Only the computer industries and the important information technology industries are indicated.

Legend*:

342 Basic electrical equipment

344 Telecommunications equipment

330 Computer manufacturing

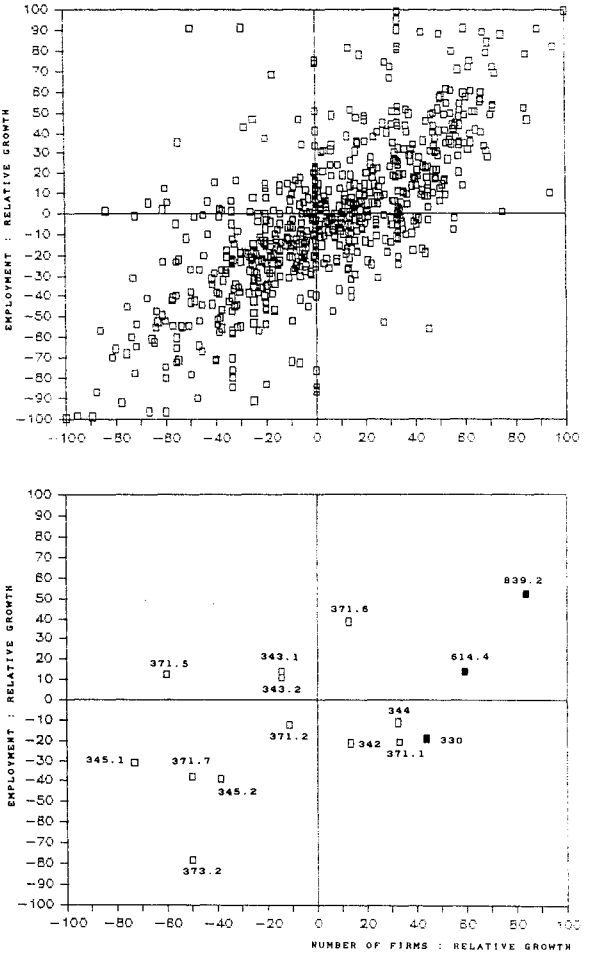
614.4 Computer trade

839.2 Computer services

345.1 Audio/video equipment

* See Appendix 2 for exact descriptions.

5B. *Relative changes* (1)



Source: INCAP

(1) For scaling purposes the indexes are calculated as $\frac{X_{83} - X_{73}}{X_{23} + X_{83}}$

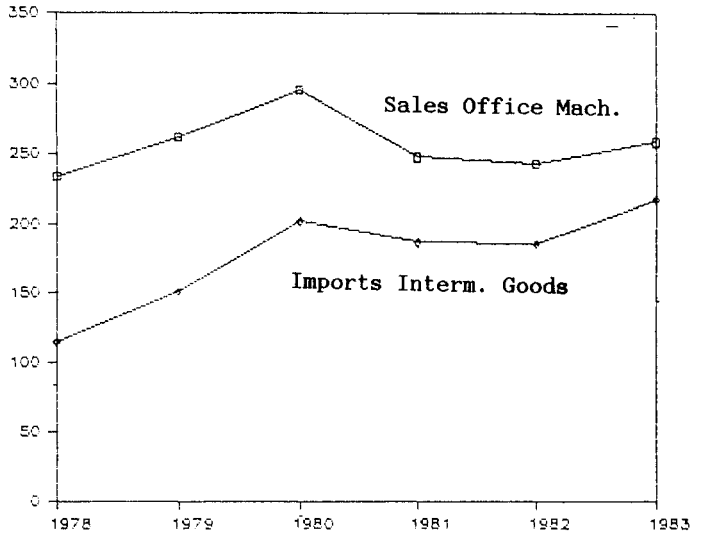
Legend*:

342 Basic electrical equipment
343.1 Electrical equipment
343.2 Batteries and accumulators
344 Telecommunications equipment
345.2 Sound records and tapes
371.2 Measuring instruments
371.6 Laboratory equipment
373.2 Optical precision instruments
330 Computer manufacturing
614.4 Computer trade
839.2 Computer services
345.1 Audio/video equipment
371.1 Liquid supply meters
371.5 Precision measurement instr.
371.7 Other precision equipment

* See Appendix 2 for exact descriptions.

FIGURE 6

Imports of intermediate goods and sales of office-machinery (*) (.000.000 $)

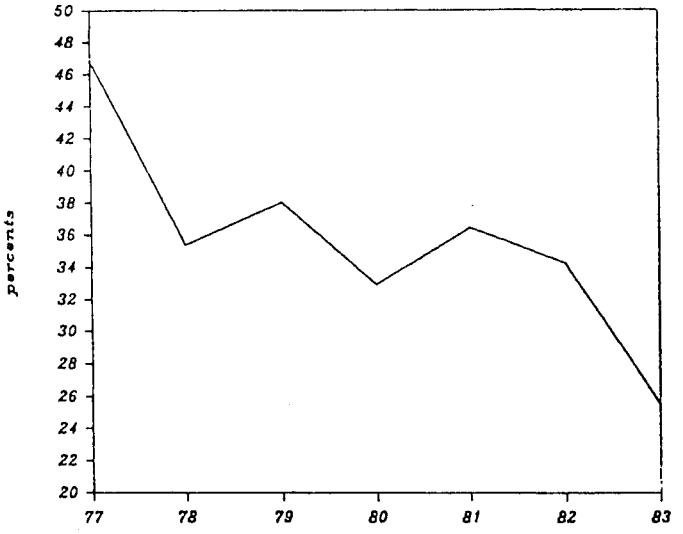


(*) Imports relate to BLEU.

Source: TVA-statistics, OECD: Trade by commodities.

FIGURE 7

Value added to sales ratio of the computer manufacturing

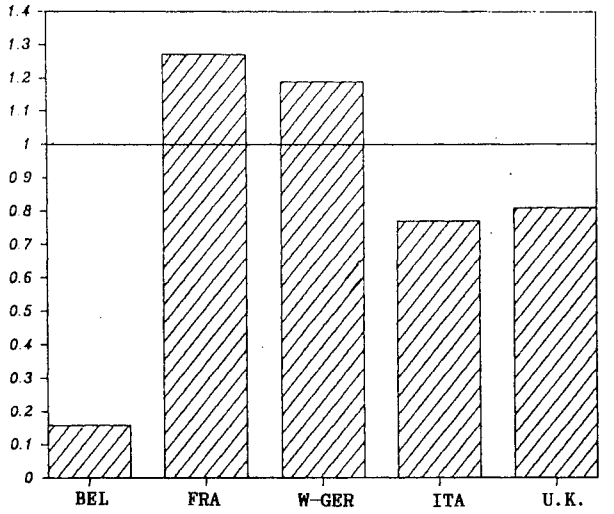


Source: TVA-Statistics.

Further evidence for the rather weak position of the Belgian computer manufacturing industry can be obtained from an international comparison of production specialisation ratios. Figure 8 reveals that in 1981 Belgium was less specialised than France and Germany.

FIGURE 8

Specialization index for computer manufacturing employment (1981)



Source: Eurostat: INDE and BISE.

In comparison with other European contries Belgium also adds little value in the manufacturing of computers (Table 5). But this reflects a wellknown structural characteristic of the computer industry in all countries. Indeed manufacturing costs are only a small share of total computer sales.

TABLE 5

Value Added to Sales Ratio for Computer Manufacturing

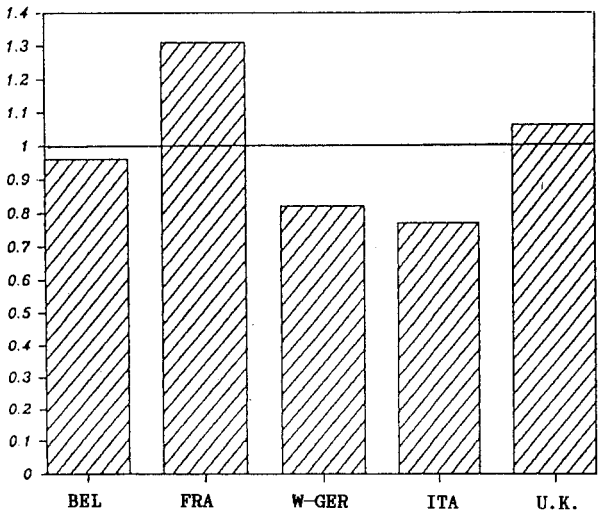
Year	Belgium	W.Germany	France	Italy	U.K.	Ireland
1977	.468	.553	.521	.602	.428	.351
1978	.354	.514	.531	.542	.459	.363
1979	.380	.511	.504	.551	.504	.407
1980	.329	.501	.498	.484	.493	NA
1981	.364	.465	.488	.463	.505	NA
1982	.342	NA	NA	NA	NA	NA
1983	.255	NA	NA	NA	NA	NA

Source: EUROSTAT, INCAP

As shown above computer trade and services are important sources for employment and value added. This is mostly due to the much higher value added to sales ratio in these activities. The Belgian economy is also more specialised in these industries than in the manufacturing of computers. Figure 9 reports the specialisation ratio for Belgium and some other European countries.

FIGURE 9

Specialization indices for employment in computer services, given total services



Source: ESCA

The regional distribution of employment is different for the various industries (Table 6). Wallonia accounts for the largest share of employment in the computer manufacturing industry. Brussels dominates in computer trade and in computer services. Flanders holds a distant second position in all three industries.

TABLE 6

Regional Distribution of Employment

	Computer manufact.	Computer trade	Computer services
Flanders	28.8	28.8	28.7
Brussels	25.2	56.3	55.0
Wallonia	45.2	11.6	14.4

IV. THE ECONOMIC IMPACT OF THE USE OF COMPUTERS AND ROBOTS

The impact of computers and robots on the economy is twofold. First, there is a substitution effect by which is meant that computers and robots are substituted for labour. Second, there is an output effect by which is meant that utilisation of computers and robots increases the competitiveness of the Belgian industries and thus stimulates output. Some indicators of both effects are reported below.

In order to trace some of these impacts Belgian industries were classified according to their degree of computerisation. A distinction was made between high computer users (more than 5% of value added spent on computers), medium computer users (more than 1.5% spent on computers) and low computer users.

High computer intensive industries account for the smallest employment share in Belgium. The largest share is held by the low computer intensive industries (Table 7). Between 1973 and 1983 employment decreased at an average annual rate of 0.45%. This decline was most pronounced in the medium computer intensive industries. Low computer intensive industries increased employment, while high computer intensive were slightly worse than average. The favourable employment performance of the low computer intensive industries is due to the increase in female employment (Table 8). The high and low computerised industries show an increasing demand for white collar workers over the last decade. In medium computerised industries blue collar workers carry the brunt of the layoffs (Table 9).

TABLE 7

Employment Shares by Computer Intensities and Sex

	Male		Female		Total	
Comp. int.	1973	1983	1973	1983	1973	1983
High	19.15	19.08	13.29	12.09	17.19	16.45
Medium	34.68	29.93	40.42	29.05	36.59	29.61
Low	46.17	50.99	46.29	58.87	46.22	53.95

Source: NIS/INS, INCAP

TABLE 8

Employment Growth 1973-1983 by Computer Intensities and Sex (Average Annual Growth Rates, Percent)

Comp. int.	Male	Female	Total
High	–0.958	–0.061	–0.720
Medium	–2.368	–2.398	–2.380
Low	0.079	3.325	1.270

Source: NIS/INS, INCAP

TABLE 9

Employment Growth by Computer Intensity and Occupation (Average Annual Growth Rates, Percent)

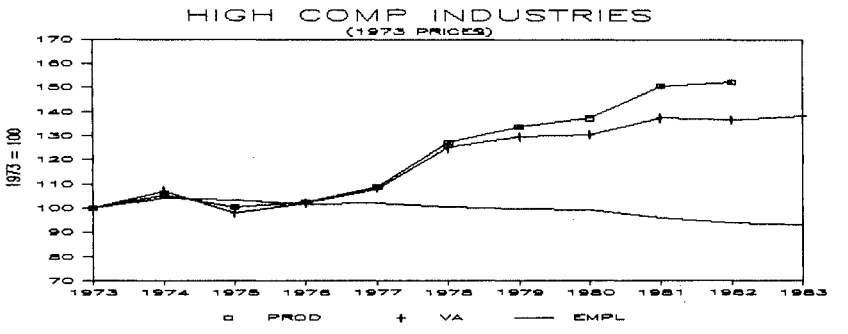
Comp. int.	Blue C.	White C.	Total
High	–2.599	0.696	–0.720
Medium	–3.620	–0.076	–2.380
Low	–0.893	2.566	1.270

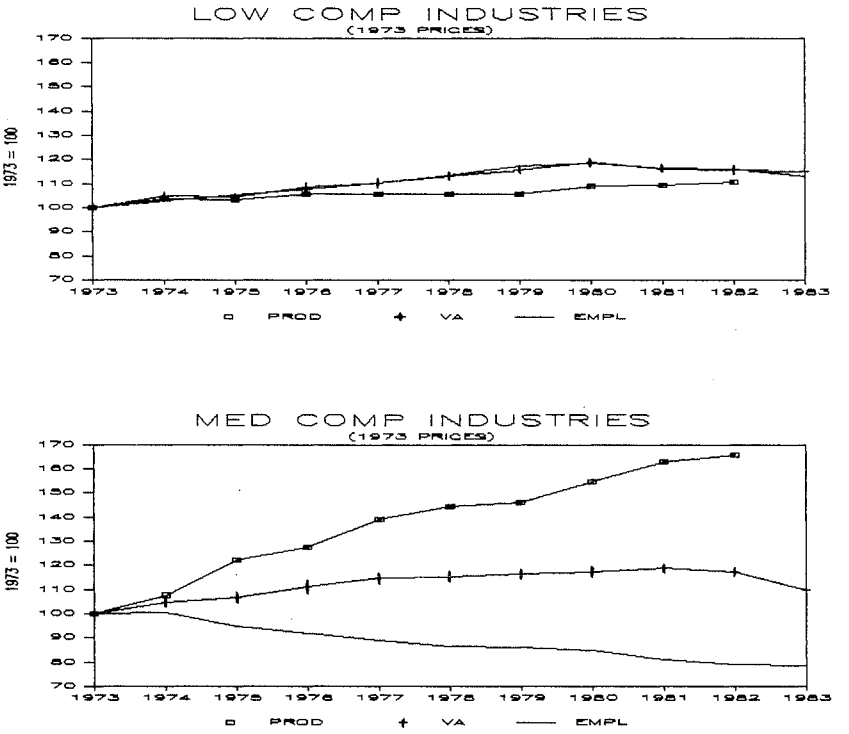
Source: NIS/INS, INCAP

To understand the global employment effects Figure 10 shows how in the high computer intensive industries the annual rates of growth of value added in contant (1973) prices (output measure) have on average been three times larger than in medium and low computerized industries. This positive trend compensates for the substitution effect, so that employment in the high computer intensive idustries compares very favourably with the strong negative trend in employment in the

FIGURE 10

Productivity, value added and employment indexes (1973 = 100) by degree of computerization





Source: INCAP

medium computer user industries. The increase in employment in the low computer industries has not been matched by similar output effects.

The key variable coupled with these employment and output movements is, of course, productivity measured as value added in contant prices per hours-worked. Both the high and medium computerised industries show a high annual growth in labour productivity. Productivity in the low computerised industries was much lower. The various sources of the productivity changes are displayed in Figure 10. In the medium computerised industries the increase in productivity appears to be a reflection of a rationalisation process and the substitution effect appears to be dominant. In high computerised industries the output effect is more important. In low computer intensive industries the same degree of efficiency does not seem to have been attained.

Increased productivity reduces unit labour costs, which in turn, have a favourable effect on prices. In high and medium computer intensive industries prices have on average increased about 6.5 percent, in low

computer user industries inflation is 2 percent higher, 8.5 percent. These differences in price evolutions among the sectors may help to explain the different evolutions of demand and output in these sectors.

The strong performance of the highly computerised industries in terms of productivity also shows up in their international competitiveness. Table 10 illustrates the increasing share held by high computerised industries in total exports and trade surplus.

The schematic analysis, presented here, can only be considered tentative at this stage. Further refined analysis should control for other crucial variables in the measurement of productivity and in the demand effects.

Detailed statistical information about the impact of the use of robots on the performance of the Belgian economy is not yet available. Information about other European countries suggests that robots may play a role in productivity gains, in ameliorating the competitive position of firms by increased product flexibility and in changing working conditions (quality and danger of work).

TABLE 10

International Trade by Computer Intensity
(Average Annual Growth Rates, Percent)

			Exports share		Imports share		Trade Balance (mill. ECU)	
Comp.int.	Exports	Imports	1975	1983	1975	1983	1975	1983
High	15.12	14.82	30.09	34.3	27.3	30.5	1565	5423
Medium	12.96	12.55	69.1	65.7	72.7	69.5	–353	647

Source: NIS/INS, INCAP

V. PERSPECTIVES ON FUTURE EVOLUTION

The previous pages detailed a number of tendencies that very probably will also characterize the near future. Without pretending to develop a complete forecast of a more distant future, it is useful to reflect on some future developments that could shape the evolution of the information sector and information technology industries in Belgium.

The growth potential of the information technology industry seems to be high. Table 11 reports forecasts about data processing expeditures by companies in some Western European countries.

TABLE 11

Total DP Expenditures ($m)

	1983	1984	1985	1986	1987	1988	1989	1990
West Germany	12,591	14,390	16,579	19,141	22,162	25,729	29,854	34,632
France	10,710	12,377	14,373	16,776	19,574	22,766	26,388	30,639
United Kingdom	10,102	11,704	13,764	16,055	18,672	21,619	24,959	28,702
Ireland	367	429	506	602	713	829	976	1,149
Italy	5,717	6,718	7,907	9,329	11,021	12,987	15,273	17,920
Netherlands	2,521	2,905	3,382	3,936	4,593	5,352	6,234	7,243
Belgium	1,534	1,772	2,048	2,389	2,784	3,236	3,752	4,347
Sweden	2,111	2,499	2,970	3,506	4,129	4,874	5,729	6,756
Denmark	1,167	1,358	1,575	1,853	2,182	2,561	3,003	3,524
Norway	1,020	1,201	1,418	1,673	1,978	2,340	2,764	3,268
Finland	934	1,106	1,283	1,491	1,741	2,021	2,352	2,740
Switzerland	2,161	2,457	2,804	3,201	3,677	4,225	4,857	5,595
Austria	1,236	1,409	1,608	1,836	2,116	2,435	2,810	3,258
Spain	2,004	2,397	2,897	3,505	4,226	5,053	6,000	7,129
Portugal	178	206	244	289	343	411	489	583
Total	54,353	63,020	73,356	85,584	99,910	116,438	135,440	157,485

Source: IDC (1984)

TABLE 12

Hardware and Software markets for PC's

($m, 1984 prices)

	1984	1985	1986	1987	1988	1989
HARDWARE						
Stand alone	453	570	639	631	618	584
Networked	42	95	317	923	1701	2730
Portable	82	153	279	361	497	634
Total	577	818	1235	1935	2816	3984
SOFTWARE						
System	30	58	132	285	495	808
System support	60	134	275	534	937	1643
Applications	100	211	464	851	1234	1793
Total	190	403	871	1670	2687	4244
GRAND TOTAL	767	1221	2106	3605	3303	8193

Source: Frost and Sullivan as published in FT 4/15/85

TABLE 13

Forecasts of Share of Software Expeditures in Total Expenditures for Micro computers by Year

1984	1985	1986	1987	1988	1989	1985-1989
24,7%	33%	41,34%	46,31%	48,83%	51,81%	47,87%

Source: Financial Times/Frost & Sullivan (1985)

TABLE 14

Forecasts for Belgian Software and Services Industries

	1984	1989	Annual growth
Package software	28%	47%	35.4%
Custom consulting	24%	21%	18.4%
Data processing	43%	28%	12.3%
Other services	5%	4%	18.7%
Total	100%	100%	

Source: IDC (1984)

As far as computer trade and services are concerned, it can be seen from Table 12 and Table 13 that by 1989 more than 50% of the combined expenditures on hardware and software for PC's will go to software.

It has been estimated that in 1984 the computer software and services industry amounted to 25 billion BF and will reach 86 billion BF in 1990. This segment of the industry is growing fast. Table 14 shows that – within this segment – not all types of products and services show a similar pattern of growth.

The opportunities appear to be in specific and custom-oriented applications. This sub-segment will be particularly important because the future expansion of the information sector will to a great extent depend on the development of this type of software. In other terms, without specific or custom-oriented application software the in-depth penetration of information technologies with new users will be retarded.

According to a recent survey of the Belgian establishments currently using information technologies, about 60% intend to change their equipment in the coming years. In the meantime there will be a ten-

dency towards changing applications. It is then interesting to have a closer look at the major changes that are likely to appear in the future.

As many authors have pointed out, computer applications were initially designed to solve specific problems and to supply specific information to specific departments and people. Next it became apparent that data collected for one application could also be used for production planning and for costing. Finally, the availability of minicomputers made distributed processing feasible in the early 70s. The consequence of this expansion of data processing power was a dispersion of computers and applications in an uncontrolled, uncoordinated and disconnected manner, which in turn resulted in rising computer costs without providing management with the data required. What seems to have happened is an acceleration of growth in the "automation" process of discrete elements. Taking as an example what occurs in manufacturing, one can observe that the use of computers in design (CAD/CAM) has evolved independently of the use of computers in inventory control or in production. Since many of these systems are dealing with a common information base, there are significant benefits to be achieved by integrating design, production and inventory. This would lead to a final stage of development characterized by more integrated systems and by an intensive use of networks.

Table 12 shows the growth of networked PC's vs stand alone PC's. This growth will very likely require the solution of a number of major issues. Some of the main issues are:

A. *Organizational issues*

Among the key issues are: qualitative changes in employment, work organization, industrial relations and attitude towards new technologies.

As regards to qualitative changes, the evidence suggests that the need for flexibility will be as strong as the need for new skills. Taking robotics as an example, various studies show that there will be a shift towards small autonomous teams of multi-skilled workers with responsibility for overall monitoring and supervision rather than direct intervention in the plant. This will be backed up by planned maintenance systems based on intervention and, once again, staffed by multi-skilled craftsmen and technicians. In turn this will require major investments in training to develop both specific and general skills to support new types of manufacturing processes.

In terms of work organization, a major point concerns the choices available about system design. There is a growing body of research which suggests that there is no single arrangement that is best. To the contrary, there are many options available and selection will depend on the strategic choices exercised by managers. The process of choice becomes more and more a search for a solution compatible with the organization.

Closely related to this issue is the attitude towards new technologies. In the past most emphasis was placed on the acceptance of new technology by workers and on changing the way in which workers approach their work. In the future new means of communication will (such as those derived from networks) pose more of a challenge at the management level. With the availability of integrated systems of technology comes the demand for thinking about organizations in systems terms. This means that the traditional way of thinking about organizations, as hierarchical, professional and centralised structures, will not be adapted to systems based on networks and decentralisation.

B. *Costs of integration*

High cost of integration can only be justified within organizational and financial arrangements if a more flexible and long term approach is taken to investment planning and evaluation. Integration in the production process, for example, is essentially a multi-criteria problem. Motives for investing in such systems are very diverse. They range from increased flexibility to labour saving, from reduced set-up times to high machine utilization, from reduced inventory to consistent product quality, just to mention a few. Clearly, such an array of criteria are not easily taken into account by traditional methods. It may even be argued that they are usually incompatible with current practices.

C. *Technical issues*

In theory, common databases and network communications provide the framework for computer integration, but in practice there are design and development issues which still need to be solved. Software compatibility appears to be one of those problems. Despite investments in software for particular systems, the integration of what may often be systems using different hardware configurations and working with different languages and protocols makes interconnection difficult.

This again poses the problem of skills. Table 15 shows the pressures on the occupational market in the United States for highly qualified specialists in the computer field. It also shows the importance of skills in the domain of telecommunication.

TABLE 15

Pressures on the Occupational Market in the Computer Field in the United States

"Top Ten" demand ranking mid-1982	Job title (and average most sought – after years of experience)	Rise in demand from mid-1981
1	Systems/Software programmers (4.2 years)	+10.1
2	Applications programmers (3.6 years)	+9.6
3	Telecommunications specialists (2.6 years)	+8.9
4	DP Auditors (3.3 years)	+8.3
5	Systems analysts (4.3 years)	+7.8
6	Data base managers (9.0 years)	+7.4
7	Software engineers (4.8 years)	+7.1
8	Systems managers (6.5 years)	+6.7
9	Software programming managers (5.9 years)	+6.2
10	DP Operations managers (8.1 years)	+5.8

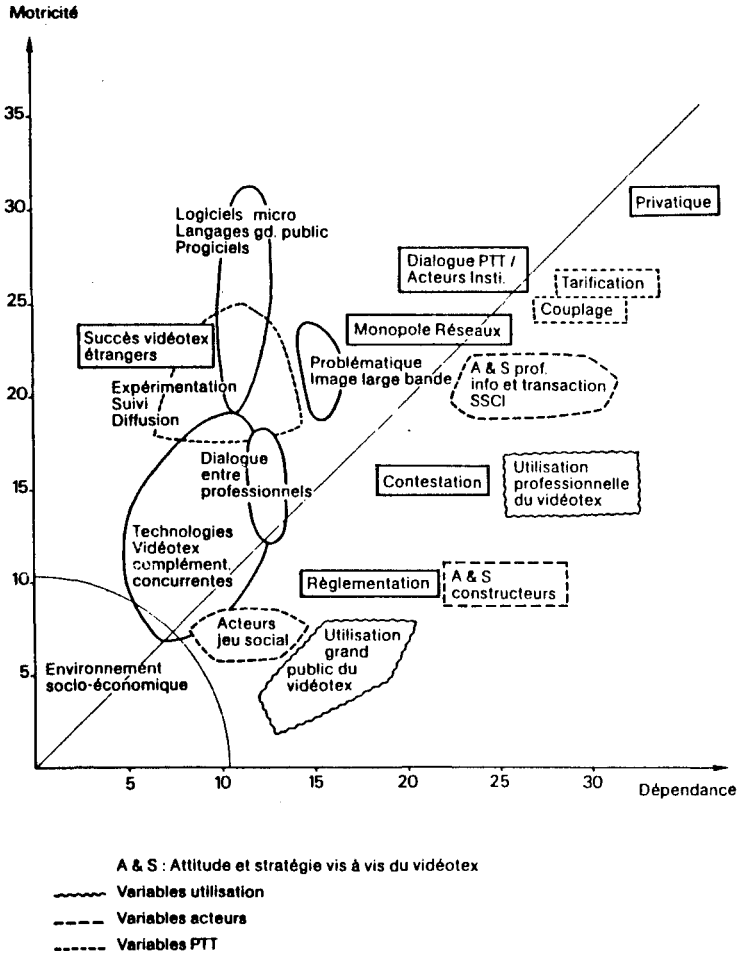
Source: Fox-Morris in OCDE (1985)

D. *Institutional issues*

A last issue worth mentioning is the one dealing with the need for new institutional arrangements. In order not to get lost in an enumeration of the wide range of potential bottlenecks, we will limit the discussion to one case among the most significative: videotex. The following figure (Figure 11) maps the various actors and variables playing a role in the diffusion of what seems to be a promising development.

Here again problems of skills, of new occupational roles, of design and development of specific software and languages abound. Moreover, given the generic nature of videotex, it is evident that no one single firm would be able to cope with the enormous diversity in user demands and requirements. In that respect the role played by telephone companies is crucial: the future will be open or closed according to the policies of the companies.

FIGURE 11
Plan Motricité-Dépendance



VI. CONCLUSIONS

Given the characteristics of the computer industry in Belgium, it is not certain that it has anything to gain from having its own production facilities for computer equipment. As a matter of fact McKinsey has argued that Europe as a whole has very little to gain from developing

its own basic computer industry. According to them more can be expected from application oriented technologies such as telecommunications, industrial automation, office automation and defense.

The information sector will continue to rely on the complementary products (goods and services) of the computer sevices segment and on the value added created by the trade activities in all of the computer goods. Technological and market forces appear to stimulate these sectors in Belgium as most promising stars in the information technology industry. The movement towards a new society will come to a large extent from the information workers operating in these sectors of our economy. It remains to be stressed, however, that the changes are wide ranging (managerial attitudes, reshaping of occupations, financial practices, institutional arrangements, etc.).

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APPENDIX 1: Components of primary information: percentages of GDP at factor cost

	Finland			France		Japan		Norway		Sweden			United Kingdom			United States		Belgium	
	1970	1975	1980	1962	1973	1960	1970	1975	1980	1970	1975	1980	1963	1972	1980	1958	1967	1975	1983
Information handling services																			
Knowledge production industries				4.6	5.0			5.7	4.3	2.76	2.98	3.8			5.0			1.35	1.88
a) *Research, Development & Investigative*	0.23	0.29	0.33			0.55	0.72						1.06	1.15		1.01	1.02	.15	.14
b) *Private Information Services* +	1.64	2.15	2.43			0.30	1.19						2.21	3.34		3.38	4.06	1.20	1.74*
Legal																			
Accounting, auditing, bookkeeping																			
Architectural, engineering, technical																			
Business services nec																			
Miscellaneous personal/repair																			
Search, Coordination and Risk Management Industries	2.62	3.86	4.32	5.1	5.2	2.39	5.61	3.1	3.4	3.19	3.30	3.6	3.59	6.23	8.7	5.19	5.41	2.30	4.31
Finance, insurance, real estate	2.38	3.55	3.96			2.24	5.34			2.92	3.02								
Miscellaneous	0.24	0.31	0.36			0.15	0.27			0.27	0.28								
Information Distribution and Communication Industries	8.45	8.88	9.71	6.1	6.2	3.48	7.00	2.5	2.5	9.15	9.18	9.3	7.12	7.83	8.5	7.86	10.30	8.63	9.89
a) *Education*	4.46	4.52	4.41	2.9	3.1	1.68	2.66			4.91	5.15	5.4	2.57	3.41	3.9	2.82	4.58	6.52	7.07
Libraries, museums and other community services	0.07	0.10	0.14			0.14	1.42			0.19	0.23		0.14	0.17		0.77	0.89	.09	.09
b) *Media of Communication*				3.2	3.1							3.4			4.6			2.02	2.73
Radio/TV broadcasting	0.24	0.23	0.34			0.13	0.21			0.10	0.10					0.33	0.29	.02	.09
Newspapers and other print/publishing	1.43	1.68	1.87			0.56	1.13			2.11	1.77		2.44	1.76		1.57	1.57	.83	.83
Telegraph and telephone services	1.66	1.63	2.06			0.65	1.22			1.48	1.57		1.95	2.49		1.72	2.45		
Postal services						0.16	0.22									0.65	0.52		
Miscellaneous	0.59	0.72	0.89			0.16	0.14			0.36	0.36							1.65	1.80
TOTAL	12.94	15.18	16.79	15.8	16.4	6.72	14.52	11.3	10.2	15.10	15.46	16.7	13.98	18.55	22.2	17.44	20.79	12.76	16.08

+ Contains computer services

* EDP-services to enterprises accounted for .064% of GDP in 1975 and .169% in 1983.

APPENDIX 1: *(cont.)*

	Finland			France		Japan		Norway		Sweden			United Kingdom			United States		Belgium	
	1970	1975	1980	1962	1973	1960	1970	1975	1980	1970	1975	1980	1963	1972	1980	1958	1967	1975	1983
Goods for information services																			
Consumption and intermediate Goods	1.56	1.52	1.91			0.57	1.41	1.7	1.6	0.40	0.39	0.72	0.64	0.99	1.1	0.44	0.51	.98	1.15
Office supplies, stationary etc.	1.13	1.04	1.36			0.04	0.00			0.37	0.36		0.39	0.50		0.24	0.26		
Photographic and optical goods etc.	0.00	0.00	0.01			0.13	0.26			0.03	0.03		0.04	0.14		0.02	0.04		
Miscellaneous (radio, TV sets, watches calculators etc.	0.43	0.48	0.54			0.40	1.07						0.21	0.35		0.18	0.21		
Investment Goods	1.87	2.65	2.25			1.12	2.89	2.8	2.4	1.43	1.95	1.58	1.42	2.47	2.6	1.75	2.54	.79	.67
Measuring and control instruments	0.31	0.52	0.57			0.57	1.33			0.14	0.18		0.36	0.39		0.85	0.73	.13	.07
Office machinery ++	0.14	0.18	0.27			0.02	0.13			0.36	0.32		0.23	0.45		0.39	0.42	.04	.09
Radio, TV & communications equipm.	0.24	0.45	0.39			0.38	0.96			0.84	1.35		0.54	0.92		0.32	0.79	.56	.48
Printing trade machinery & equipment	0.74	0.84	0.66							0.09	0.10		0.09	0.09		0.08	0.07	.06	.03
Miscellaneous electronic components and accessories	0.44	0.66	0.36			0.15	0.47						0.20	0.62		0.11	0.53		
TOTAL **	3.43	4.17	4.16	2.7	2.7	1.69	4.30	4.5	4.0	1.83	2.34	2.39	2.06	3.46	3.7	2.19	3.05	1.76	1.82
Total Primary Information Sector	16.37	19.35	20.95	18.5	19.1	8.41	18.82	15.8	14.2	16.93	17.80	19.0	16.04	23.01	25.8	19.63	23.84	14.52	17.90

++ Contains computer manufacturing.

** Trade is not included and amounted to .87% of GDP in 1975 and 1.71% in 1983 (Belgium) and computer trade amounted to .20% and .31% respectively.

Source: OECD (1984, p. 12-13) and INCAP, KUL for the Belgian data.

APPENDIX 2: *Information Technology and Computer Industries (NACE 3 and 4 digit)*

"Information technology Industries"

342 Electric motors, electricity generators, transformers, switches and other basic electrical equipment
343 Electrical apparatus, appliances and equipment for industrial use; batteries and accumulators
343.1 Electrical apparatus, appliances and equipment for industrial use
343.2 Batteries and accumulators
344 Telecommunications equipment, electrical and electronic measuring and recording equipment and electro-medical equipment
345 Radio and television receivers, sound recproducing and recording equipment, electronic equipment and apparatus; gramophone records and prerecorded magnetic tapes (excluding telecommunications, measuring, recording and electro-medical equipment and electronic computers)
345.1 Radio and television receivers, sound reproducing and recording equipment, electronic equipment and apparatus (excluding telecommunications, measuring, recording and electro-medical equipment and electronic computers)
345.2 Gramophone records and prerecorded magnetic tapes
371 Measuring, checking and precision instruments and apparatus
371.1 Gas meters, water meters and other liquid supply meters (including petrol pump meters)
371.2 Measuring, checking or automatically controlling instruments and apparatus
371.3 Equipment for navigation, hydrology, geophysics and meteorology
371.4 Drawing and mathematical calculating instruments
371.5 Precision measuring instruments
371.6 Precision balances, laboratory equipment, teaching equipment
371.7 Other precision equipment and apparatus
373 Optical instruments and photographic equipment
373.1 Spectacles, lenses, frames and mountings (including equipment for use by opticians)
373.2 Optical precision instruments (other than opticians items)
373.3 Photographic and cinematographic equipment

"Computer industries"

330 Office machines and data-processing equipment
614.4 Wholesale of office machines and of other technical administration aids
839.2 Electronic data processing for account of thirds